



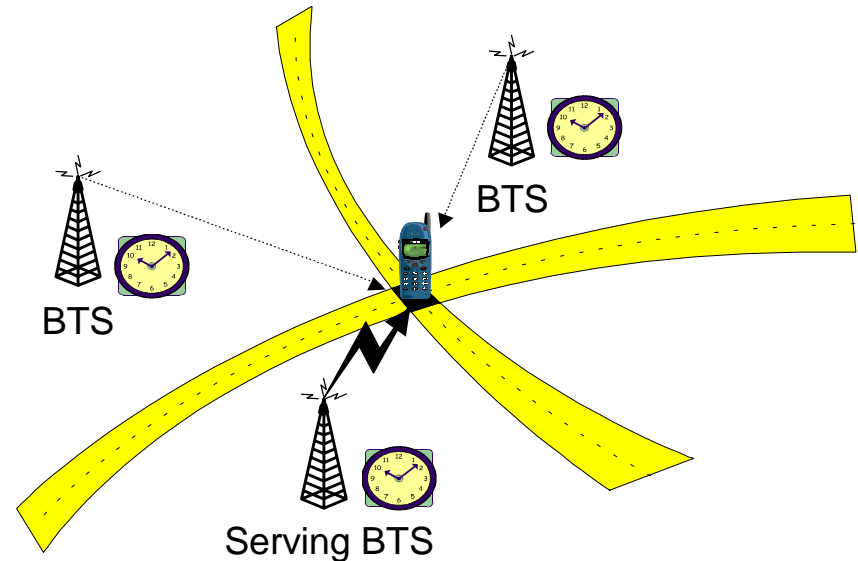
E-OTD Location Technology Trial Phase I Results

EOTD Location Method

E-OTD Network Operation

- Mobile listens to bursts sent from neighboring BTSs
- Mobile records burst arrival times
- Position is triangulated from:
 - Coordinates of BTSs
 - Burst arrival time from each BTS
 - Timing differences between BTSs

3G Systems use E-OTD as the intrinsic method for position determination



E-OTD - Handset Implementation



- ← No Change to Antenna Structure
- ← No Change to DSP or RF Hardware
- ← Software Modification Required to Enhance Existing Measurements Process

Trial Description & Goals

- **Understand the accuracy of EOTD**
 - In suburban areas
 - In commercial suburban areas
 - In building / In car / Outdoor
- **What factors impact the performance of EOTD and how**
 - Effects of LMU density
 - Effects of BTS visibility from mobile
 - Effects of BTS visibility from LMU
 - Effects of cell geometry
 - Effects of LMU Antenna Placement
 - Effects of mobile velocity



Trial Description & Goals

- **Trial Area**
 - 325 Km² trial area in Houston commercial/suburban setting
- **Equipment**
 - CPS E-OTD LMUs co-located with 19 contiguous BTS
 - Sites comprised of rooftops and towers
 - **LMU Antennas**
 - Rooftops: mag mount omni mounted on BTS cabinet
 - Towers: 9dbi omni mounted to ice bridge or equivalent, some mounted 10m up tower to improve line of sight and visibility
 - **Mobiles**
 - Mitsubishi handsets flashed with CPS EOTD software
 - **MLC**
 - SUN E250 with software provided by CPS for location calculation and operation and maintenance of LMU network
 - **Messaging run over SMS in the VoiceStream Houston network**



Trial Plan and Phase I Description

- **Implementation / Deployment / Commissioning**
 - Begin April 2000
 - Design LMU network
 - Customize the messaging interfaces in the network
 - Deploy LMUs with associated antennas and SMLC
 - Commission System through field testing
- **Phase I Testing**
 - Begin July 2000
 - Stationary testing in idle mode, in-car / outdoor
 - Involve GSMNA operators and equipment vendors
 - Invite operators and vendors to test July 31 – August 11
 - Distribute all results and detailed report to trial participants by September 1



FCC Guidelines vs. Testing Methodology

- **Phase I Testing Methodology**
 - Trial area divided into 67 test grids
 - 4 random measurement locations per test grid to allow for uniform distribution
 - 5 individual measurements per location
 - 3 minutes between measurements to allow for independent results in idle mode
 - Over 1000 In-car and outdoor measurements in suburban radio environment collected
 - Data is collected by pressing a button on the handset and recording the returned position
 - The position is provided in real time
 - Testing period July 28th – August 14th



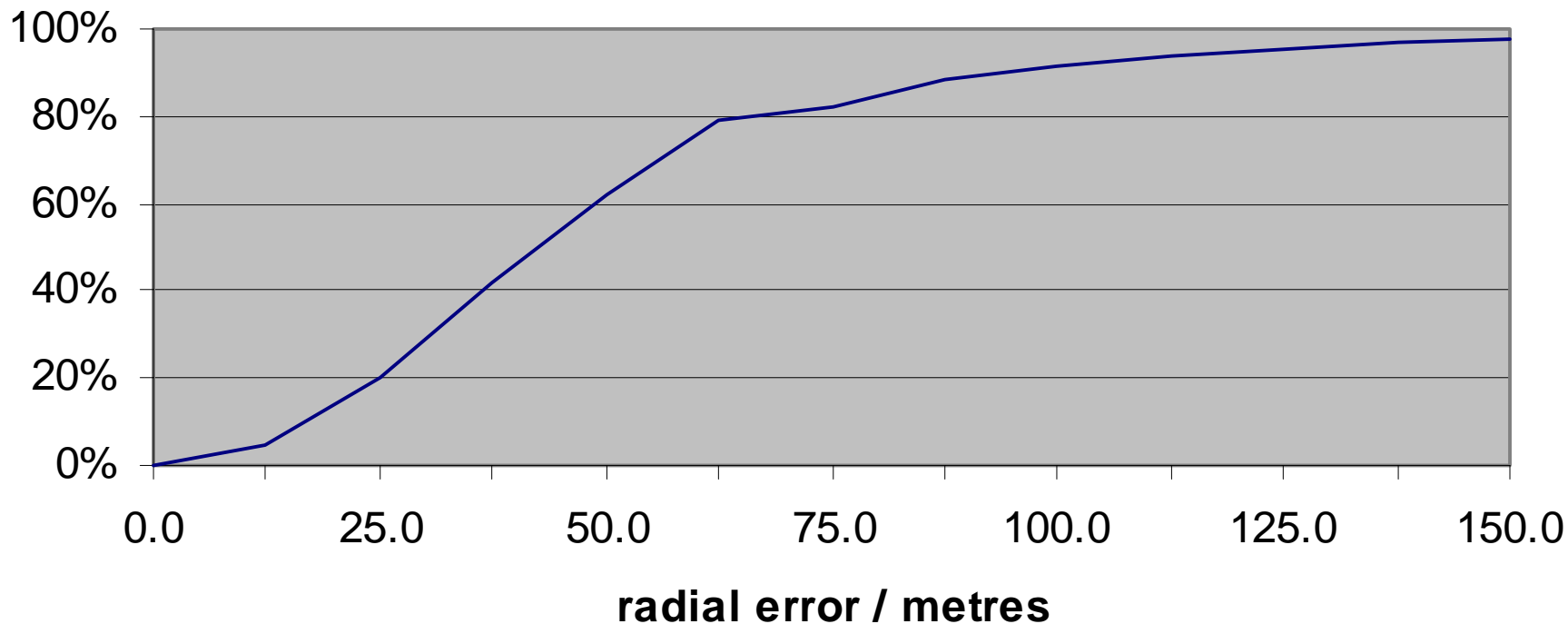
FCC Guidelines vs. Testing Methodology

- **FCC Compliance Guidelines**
 - Testing allows scaling by actual 911 call distribution
 - Allows 30 seconds for successive location fixes
 - Moving measurements to be used when a suitable testing platform is available, this is in development presently
- **Conclusions**
 - The data presented does *not* accumulate measurements throughout a call to improve accuracy
 - Stationary measurements are allowable
 - No in-building measurements made
 - Distribution of measurement locations in suburban radio environment representative of ~ 70% of wireless 911 calls
 - Active mode operation with 30 seconds additional measurements will improve accuracy



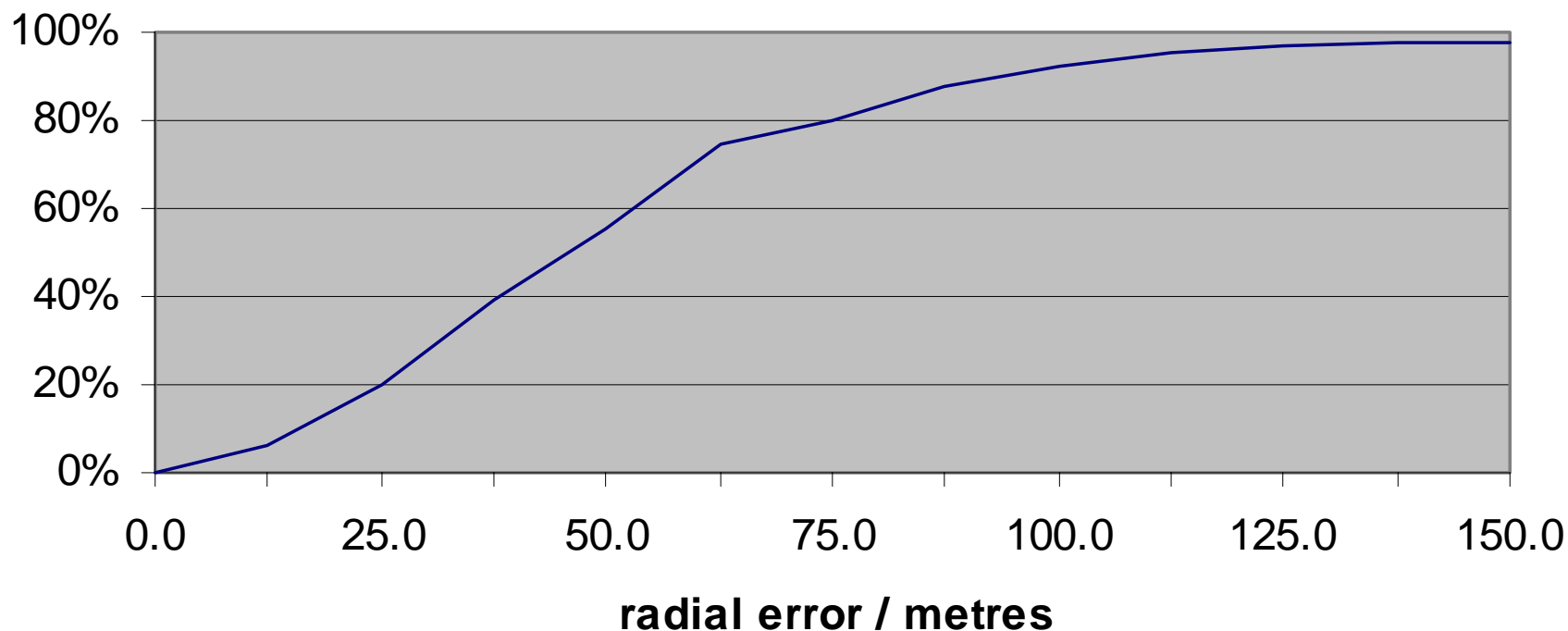
Phase I Results: Outdoor Measurements

Cumulative error distribution - outside



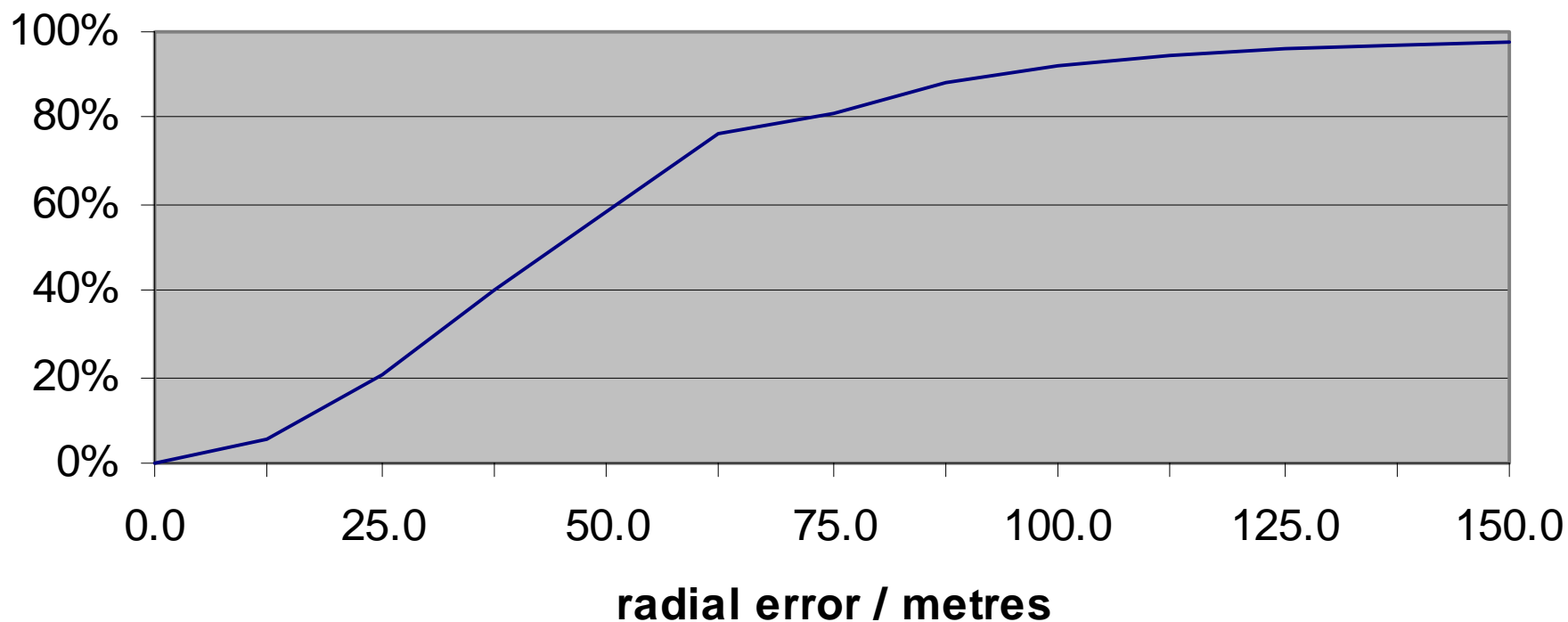
Phase I Results: In-vehicle Measurements

Cumulative error distribution - inside



Phase I Results: All measurements

Cumulative error distribution - all



Phase I: Results Summary and Conclusions

All Measurements	Inside the vehicle	Outside the vehicle
58.6 % within 50 m	55.5 % within 50 m	61.8 % within 50 m
67.0 % within 57 m		
92.0 % within 100 m	92.4 % within 100 m	91.6 % within 100 m
97.5 % within 150 m	97.5 % within 150 m	97.6 % within 150 m

- The results indicate that E-OTD can approach the handset accuracy requirements of the FCC in these areas
- E-OTD appears, at this stage, to perform well in areas representing ~ 70 % of E911 calls
- Full data set is 7m over the 50m accuracy limit
- Full data set exceeds the 150m (95%) accuracy statistic
- Full data set fully meets accuracy rules in VoiceStream waiver

